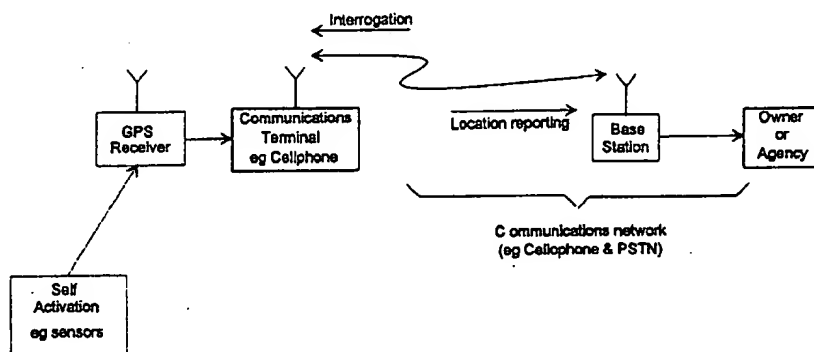




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/NZ94/00144 <b>(22) International Filing Date:</b> 20 December 1994 (20.12.94) <b>(30) Priority Data:</b> 250530 20 December 1993 (20.12.93) NZ <b>(71) Applicant (for all designated States except US):</b> INDUSTRIAL RESEARCH LIMITED [NZ/NZ]; Gracefield Road, Lower Hutt 6009 (NZ). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> VAUGHAN, Rodney, Grant [NZ/NZ]; 12 Junction Street, Lower Hutt 6009 (NZ). SCOTT, Neil, Llewellyn [NZ/NZ]; 22 Kopara Grove, Stokes Valley 6008 (NZ). <b>(74) Agents:</b> WEST-WALKER, Gregory, James et al.; West-Walker McCabe, 3rd floor, Fraser House, 160-162 Willis Street, Wellington 6001 (NZ).		<b>(81) Designated States:</b> AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).  <b>Published</b> <i>With international search report.</i>

(54) Title: RADIO LOCATION DETERMINATION AND NOTIFICATION



## (57) Abstract

A radio location unit comprises a location system terminal part which determines location information indicating the physical location of the radio location unit from a global or regional navigational location system such as GPS, and a communication system terminal part arranged to report the location information from the unit over a communications network such as a cellular telephone network. The location system terminal part provides location information data to an interface between the location system terminal part and communication system terminal part which interface unit is arranged to process the location information data into a communications protocol or format. The unit may be programmable to report location information at periodic and programmed time intervals, or when polled.

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## RADIO LOCATION DETERMINATION AND NOTIFICATION

### FIELD OF INVENTION

The invention comprises a radio location unit for location and reporting information.

A problem frequently arising is that of locating mobile equipment. This problem applies to tracking and monitoring fleet vehicles as well as to individual equipment or goods. One example is monitoring the position of a cargo container in transit. The container may be carried by several different means of transportation and be required to wait in several different distribution centres. This invention addresses the problem of notifying the owner or agent of its location. Another example is that of equipment or goods that are subject to theft or otherwise becoming lost. This invention allows notification of the location of the items without knowledge of the intended or anticipated location.

### BACKGROUND ART

#### Location System Terminals

Known location and navigation systems such as the Global Positioning System i.e. GPS, LORAN etc provide mobile terminals with the ability to determine their location.

These systems vary greatly from small handheld units to large installations of equipment. Systems such as GPS use satellite base stations emitting carefully designed

and timed signals which allow a compatible receiver to calculate its own position. Other systems use base stations located on land at known locations on the earth. Regardless of the system the operator of one of these location system terminals is presented with location and/or navigation information appropriate to the location of the terminal that they are operating.

### **Communication System Terminals**

Radio communications networks now provide widespread coverage. Cellular phones, for example, allow the user to move freely over large areas, without any obvious disruption of service from place to place. These communications networks therefore provide the facilities for a compatible terminal device to communicate over a large area without prior knowledge of the movements to be undertaken. The use of modems is now widespread. Modems allow digital information to be communicated over virtually any communications link. Examples of communications links of this sort include telephone calls, cell phone calls, mobile telephone calls, fibre optic cables, microwave radio links. Many communications links explicitly provide facilities for digital information communication. Examples of this type of link include advanced digital cell phones, GSM and DAMPS.

## **GENERAL DESCRIPTION OF INVENTION**

In broad terms the invention comprises a radio location unit incorporating a location system terminal part which determines location information from global or regional navigation or location system, and a communications system terminal part

arranged to report the location of the unit from the unit over a communications network.

The location system terminal determines the physical location of the radio location unit and provides location information to the communications terminal part in machine compatible form. For example the location terminal may comprise a compact GPS terminal with RS232-C output capacity. Other location terminal technologies besides GPS may be used. Also alternative software and/or hardware interfaces may be employed including I<sup>2</sup>C, parallel memory and IO bus mappings, and full communication protocol implementations.

The communications terminal part communicates the location information transferred from the location system terminal, for example to the owner or agent. For example the communications terminal part may comprise a cellular telephone terminal which reports the location information over a cellular telephone network. Such a cellular telephone based communications terminal may report the location information through any other communications network however, such as plain old telephone systems (POTS), fibre optic networks, microwave systems. These network systems may be proprietary or public systems provided by a network provider. Examples of systems envisaged as "public" include: Telecom Cellular, AMPS, DAMPS, GSM, FM or AM dispatch systems.

The radio location unit of the invention may be designed to be handheld, vehicle mounted, or housed in any convenient way attached to the item or items to be located or tracked.

The communicated information includes location information. The location information from the location terminal part may be in a raw form from which location may be derived, or in a fully processed form. The location information may be coded in any desired format. For example the location information may be raw signals derived from the location system. These may be digitally coded and transmitted unprocessed by the radio location unit of the invention. Alternatively the radio location unit may process the initial location data and transmit the processed location information to a particular communications protocol and/or data structure. The location information may be optionally processed into a human recognisable form such as for example synthesised or sampled speech. The location information may contain the latitude and longitude of the radio location unit or any other information which allows location to be derived. The information may provide location on a global, regional or localised scale. The information may be coded or embodied in a packet or stream structure or any other communications protocol or format. Similarly the interface may transform the information and/or its format or representation before communication to the owner or agent.

The location system part which derives its location from a compatible location or navigation system such as GPS may operate continuously or only upon activation by polling for example. The location information from this section may also

be available to the communications terminal part for reporting either continuously or also only upon request or activation of the radio location unit.

The interface section reformats, reframes, translates, interprets, modulates demodulates or otherwise converts the format and representation of the location information into a form compatible with transmission to the communications terminal. The interface section may perform a control role to initiate activity, as further described below.

The preferred form of the invention shown in the drawings comprises a small GPS terminal connected via an interface to a data-compatible cellular phone. The GPS terminal continuously monitors its location and communicates or makes the current location information available to the cellular phone terminal via a data interface. At predetermined timed intervals the interface section initiates latches the location information and initiates a cellular phone call to report the location information to an owner or agent for example. The interface section transfers the information to the cellular phone terminal which is then reported over the medium of the cellular phone call. Upon completion of the data transmission the cellular phone is instructed to hang up and the cycle stops until the interface initiates the next.

In an alternative arrangement the radio location unit may be arranged to receive a security input which initiates location reporting upon receipt of such a security alarm. Examples include forced entry detection in vehicle and storage containers which would initiate sending of a radio alarm signal including location information indicating

the location of the vehicle or storage container at the time of the security alarm actuation and motion detectors which also indication location at the time they are activated.

Alternatively, again the radio location unit and particularly the interface part may be programmable to allow a predetermined sequence or times of initiations to take place. A location and notification sequence may be initiated by receiving and answering a poll from the owner or agent. In an implementation using a cellular phone compatible communications terminal this poll may be as simple as a call to the terminals associated number. A location information report from the radio location unit initiated by the device itself, by the owner or agent, or by some other event, may transfer central information to the device from a remote point. For example the frequency of timed initiations could be programmed from a remote point.

The radio location unit of the invention may be arranged to communicate its location information to multiple sites. The device may initiate communication to more than one site by using a compatible broadcast network that allows one to many dispatch type calls. Alternatively the device may maintain a list of sites to notify. A cellular phone compatible communication terminal may maintain a list of numbers to call and notify. An implementation capable of answering a poll may allow communication of the information to any caller. This communication sequence may optionally include an identification phase to verify a right to receive the information before it is transferred.



## DESCRIPTION OF DRAWING

The invention will be further described with reference to the accompanying drawing by way of example which illustrates the system of the invention.

## DESCRIPTION OF PREFERRED FORM

Referring to Fig. 1 the preferred form unit comprises a GPS receiver and a cellular phone communications terminal. The GPS receiver terminal determines the location of the unit and transfers location bearing information either as raw data or processed information e.g. latitude and longitude, to the communications terminal. The communications terminal reports the location bearing information to the receiver such as an owner or agent via an existing communications network through typically a base station. Reporting of location information may be initiated by interrogation of the unit over the communications network.

Fig. 1 illustrates, by way of example, a configuration of the invention using the GPS positioning system and cellular phone networks. A possible sequence for events for an interrogation system is:

- \* The owner, or agent, initiates a call over the PSTN and cellular phone network to the device.
- \* The device answers the call.
- \* After establishing the connection, the device transfers location bearing information back to the owner or agent. This information could be in the

form of raw data from the positioning system, partially processed data from which location is derivable, or fully processed data providing location directly.

The figure also shows optional self activation. In this mode, sensors at the device initiate the report. This could consist of security sensors to detect movement, sound, electrical supply changes etc. The sequence is then initiated at the device:

- \* The sensors recognise a condition requiring notification.
- \* The device initiates a call over the cellular phone and the PSTN networks to the owner or agent.
- \* Personnel or equipment at the destination answers the call.
- \* After establishing the connection, the device transfers location bearing information back to the owner or agent. This information could be in the form of raw data from the positioning system, partially processed data from which location is derivable, or fully processed data providing location directly.
- \* The device may optionally maintain the connection or disconnect.

The foregoing describes the invention and alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof as defined in the accompanying claims.

## CLAIMS

1. A radio location unit incorporating a location system terminal part which determines location information indicating the physical location of the radio location unit, from a global or regional navigational location system, and a communication system terminal part arranged to report the location information from the unit over a communications network.

2. A radio location unit according to claim 1, wherein the location system terminal part provides location information data to an interface between the location system terminal part and communication system terminal part, which interface unit is arranged to process the location information data into a communications protocol or format.

3. A radio location unit according to claim 2, which is programmable to report location information at periodic and programmed time intervals.

4. A radio location unit according to claim 2, which is programmable to report location information on occurrence of an event local to the radio location unit.

5. A radio location unit according to claim 2, which is programmable to report location information only on polling of the radio location unit from a distant source.

6. A radio location unit according to any one of the preceding claims, wherein the location system terminal part comprises a Global Positioning System terminal.

7. A radio location unit according to any one of the preceding claims, wherein the communication system terminal part comprises a terminal which communicates over a cellular telephone network.

8. A radio location unit as claimed in any one of the preceding claims which is of a size intended to be handheld by a user.

9. A radio location unit as claimed in any one of the preceding claims which is adapted to be physically attached to an object or item to be tracked.

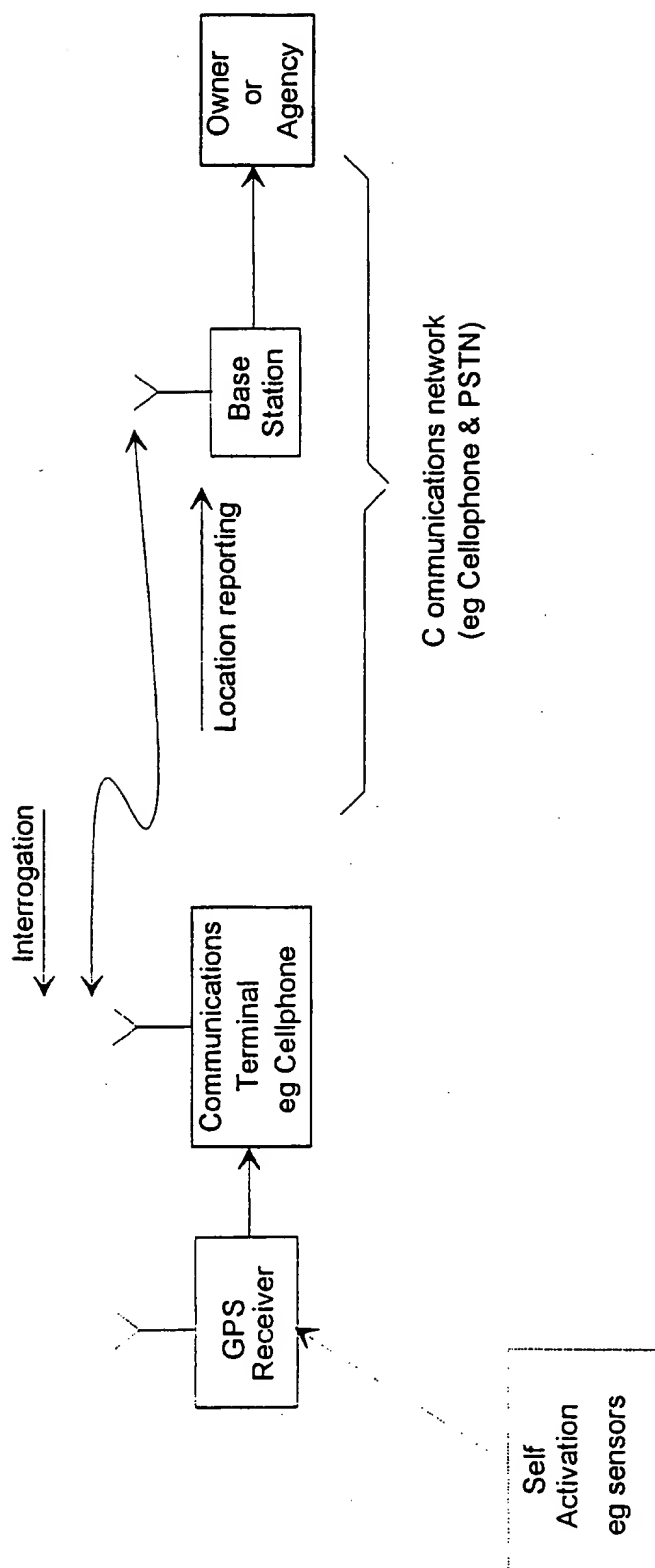
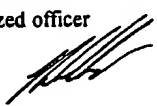


FIG. 1

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 94/00144

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> Int. Cl. <sup>6</sup> G01S 5/10  According to International Patent Classification (IPC) or to both national classification and IPC					
<b>B. FIELDS SEARCHED</b>  Minimum documentation searched (classification system followed by classification symbols) IPC : G01S 5/10  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above & G01S 5/12, 5/14, 5/02  Electronic data base consulted during the international search (name of data base, and where practicable, search terms used) WPAT, JOPAL					
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>					
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.			
X	US,A, 5225842 (BROWN et al) 6 July 1993 (06.06.93) column 4 lines 49/62 column 6 lines 34/42 column 8 lines 1/8	1-3, 6-9			
X	US,A, 5223844 (MANSELL et al) 29 June 1993 (29.06.93) column 1 lines 7/12 column 2 lines 31/36 column 2 lines 55/68 column 3 lines 1/7 column 15 lines 47/49	1,2,4,6,7,9			
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input checked="" type="checkbox"/> See patent family annex.</span> </div>					
<table style="width: 100%; border: none;"> <tr> <td style="width: 33%; vertical-align: top;">           * Special categories of cited documents :             "A" document defining the general state of the art which is not considered to be of particular relevance            "E" earlier document but published on or after the international filing date            "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)            "O" document referring to an oral disclosure, use, exhibition or other means            "P" document published prior to the international filing date but later than the priority date claimed         </td> <td style="width: 33%; vertical-align: top;">           "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention            "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone            "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art            "&amp;" document member of the same patent family         </td> <td style="width: 33%;"></td> </tr> </table>			* Special categories of cited documents :  "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
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Date of the actual completion of the international search 24 February 1995 (24.02.95)		Date of mailing of the international search report 3 Mar 1995 (03.03.95)			
Name and mailing address of the ISA/AU  AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA  Facsimile No. 06 2853929		Authorized officer   R. FINZI  Telephone No. (06) 2832213			

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 94/00144

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	US,A, 5043736 (DARNELL et al) 27 August 1991 (27.08.91) Abstract column 1 lines 6/15 column 2 lines 21/27 column 2 lines 40/44 column 4 lines 5/13	1,2,6-9
X	EP,A2, 242099 (ADVANCED STRATEGICS INC) 21 October 1987 (21.10.87) Abstract page 2 lines 4/5, 42/43, 48/49 page 3 lines 1/3, 34/42, 46/51 page 4 lines 18/20, 35/39 page 5 lines 14/24	1,2,4-9
X	WO,A1, 90/08371 (COLES, C.F.) 26 July 1990 (26.07.90) page 4 lines 12/19 page 7 lines 15/25, 28/35 page 8 lines 1/6 page 9 lines 1/4, 11 claims	1,2,4,6,8,9
X	WO,A1, 89/12835 (BROWN, K.C.) 28 December 1989 (28.12.89) page 1 lines 6/10 page 2 lines 6/19, 26/36 page 3 lines 1/6, 13/30 page 4 lines 16/22 page 6 lines 17/30 page 7 lines 2/14 page 8 lines 14/15	1,2,5-7,9
X	AU,A, 82677/91 (CAE LINK CORPORATION) 25 February 1993 (25.02.93) page 3 page 6 lines 17/27	1,2,6-9
X	GB,A, 2264837 (KOKUSAL DENSHIN DENWA COMPANY LIMITED) 8 September 1993 (08.09.93) page 1 page 5 lines 14/22 page 6 lines 1/13 page 8 lines 20/24 page 22 lines 21/25	1-3,6,7,9

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/NZ 94/00144

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5225842	AU	14997/92	CA	2066831	EP	512789
		JP	5180925				
US	5223844	NONE					
US	5043736	NONE					
EP	242099	CA	1277400	JP	63024395		
WO	9008371	AU	48260/90				
WO	8912835	AU	37675/89	EP	420890	GB	2221113
GB	2264837	JP	5232210				
AU	82677/91	NONE					
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